

Enabling Machine Intelligence in Healthcare Through Modern Standards

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Our Goals

- > **Introduce interoperability & information exchange**
- > **Describe past & present standards**
- > **Introduce Web APIs**
- > **Predict the future** 🕒 🦄
- > **CDS Hooks Hacktivity**



Rationale



Electronic Health Data

- > Health data first captured electronically in the 60s**
- > Benefits include accuracy & timely access (and?)**
- > Data sharing: turns out it's not that easy (why?)**



Interoperability



☐ **Interoperability**

> Extent to which systems and devices can

- Exchange data
- Interpret that shared data

> Essential for

- Continuity of care
- Monitoring & Evaluation
- Public Health Surveillance



Vocabularies



Vocabularies

- > **Systems used to encode clinically data for universal understanding**
 - diagnoses
 - orders
 - lab tests and results
 - billing
 - etc.



Vocabularies

> LOINC

- 66801-2: How well can you tell a funny event to a group of children



Vocabularies

> LOINC

- 66801-2: How well can you tell a funny event to a group of children

> SNOMED CT

- 112630007: Funny looking kid (FLK)



Vocabularies

> LOINC

- 66801-2: How well can you tell a funny event to a group of children

> SNOMED CT

- 112630007: Funny looking kid (FLK)

> ICD-10

- V91.07: Burn due to water-skis on fire



Vocabularies

> Unified Medical Language System (UMLS)

The UMLS integrates and distributes key terminology, classification and coding standards, and associated resources to promote creation of more effective and interoperable biomedical information systems and services, including electronic health records



Web APIs



Web APIs

- > **Application Programming Interfaces**
- > **Clearly defined protocol for inter-application communication**
- > **Exists at all levels**
 - Operating system
 - Libraries and frameworks
 - Remote (RPC & Web)

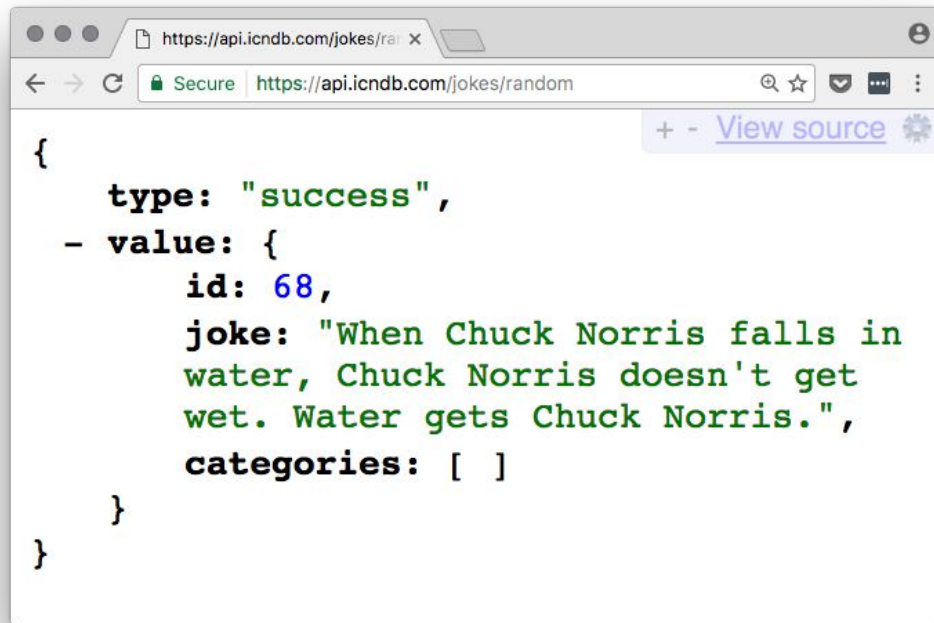


REST

- > **Representational State Transfer**
- > **Build on top of HTTP**
- > **Entities identified by URIs (web URLs)**
 - `https://api.com/rest/v1/Resource/123`
 - `https://uwmedicine.org/fhir/stu3/Patient/456`



REST



```
{
  type: "success",
  - value: {
    id: 68,
    joke: "When Chuck Norris falls in
water, Chuck Norris doesn't get
wet. Water gets Chuck Norris.",
    categories: [ ]
  }
}
```

W

The Standards



Three Tier Model

- > **Tier 1: “Simple” data exchange**
 - HL7 V2, HL7 V3, FHIR
- > **Tier 2: Application logic and patient data binding**
 - SMART on FHIR
- > **Tier 3: Omnipotent Clinical Intelligence**
 - CDS Hooks



Tier One: Exchange

> Simple Patient Data Exchange

- Transport
- Message
- Flow



Transport

> **TCP/IP**

> **SOAP**

> **REST**



Message

- > **Health Level Seven (HL7)**
 - Non-profit organization est. 1987

- > **Standards**

- 1987
 - > HL7 v2
- 1985
 - > HL7 v3
 - > CDA
- 2013
 - > FHIR 





- > **IHE Profiles**
 - XDS etc
- > **FHIR Profiles**
 - Constrain vocabularies and resources



FHIR

- > **Actively under development**
- > **Developer Focused**
 - **Web Native**
 - **Great tooling**
- > **Addresses previous shortcomings**
 - **Common scenarios**
 - **Profiles + Extensions**
 - **Free**



FHIR

> FHIR Resources

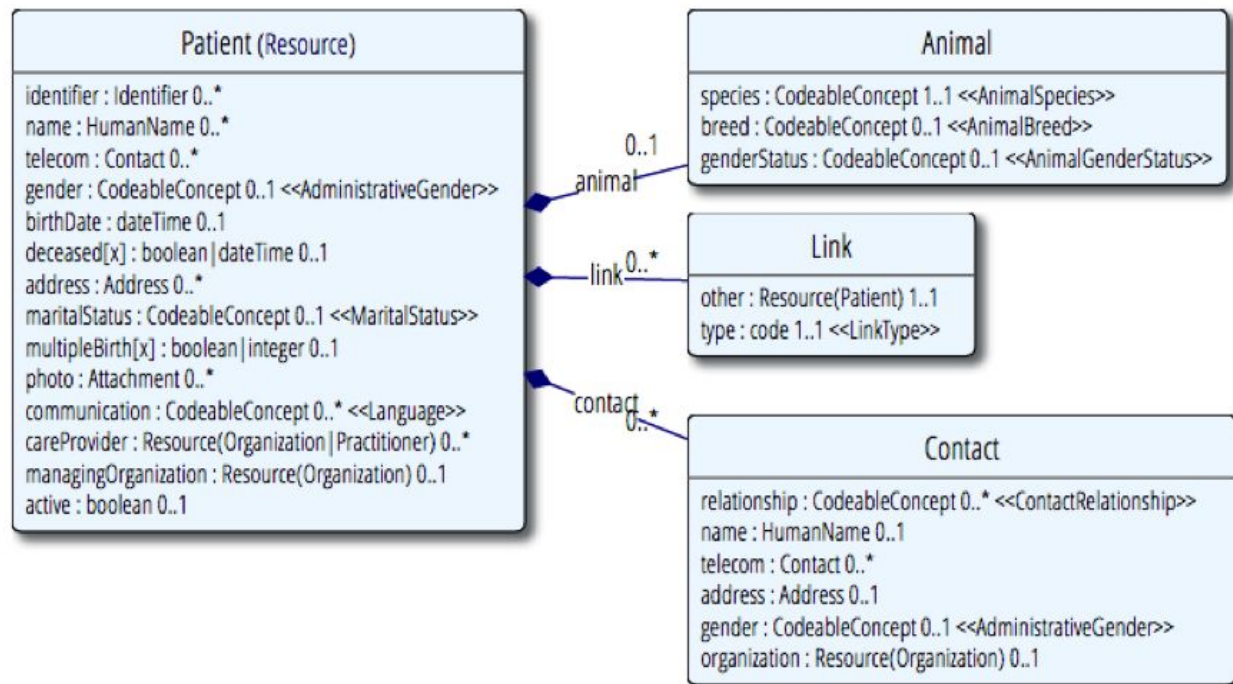
- Patient
- Observation
- Medication
- Practitioner
- Procedure
- 120+ total

> Domains

- Clinical
- Financial
- Specialized (e.g. ResearchStudy)



FHIR



Tier Two: Application Logic

- > Launch app with relevant context**
- > Delegate authentication**
- > Allow for scope data access**



SMART on FHIR® – Open Platform Architecture



CARE TEAM



Family
Medicine Ph...

ACTIVITIES

FHIRWorks



mPOWER



Test Results



Messages



Appointments



Medications



Health
Reminders



Health
Summary



Billing



Questionnaires

mpower-dev.cirg.washington.edu

Important!

If you have concerns about your wound,
contact the clinic.

Clinic staff do not get notified automatically when you
track your wound in mPOWER.

If you contact the clinic, let them know you have been
using mPOWER to record symptoms and wound
photos.

Continue to mPOWER



Tracking history

See your progress over time



Information

Wound care, discharge info, FAQs



Contact care team

Communicate with your care team

mPOWER (NO...

mPOWER - Development version - not for clinical use.

mPOWER

Menu

You're tracking your recovery from procedure on
03/15/2017.

What would you like to do today?



Track your wound

Please track your wound today



Take a picture

Upload a photo of your wound



Tracking history

See your progress over time



Information

Wound care, discharge info, FAQs



Contact care team

Communicate with your care team



Settings

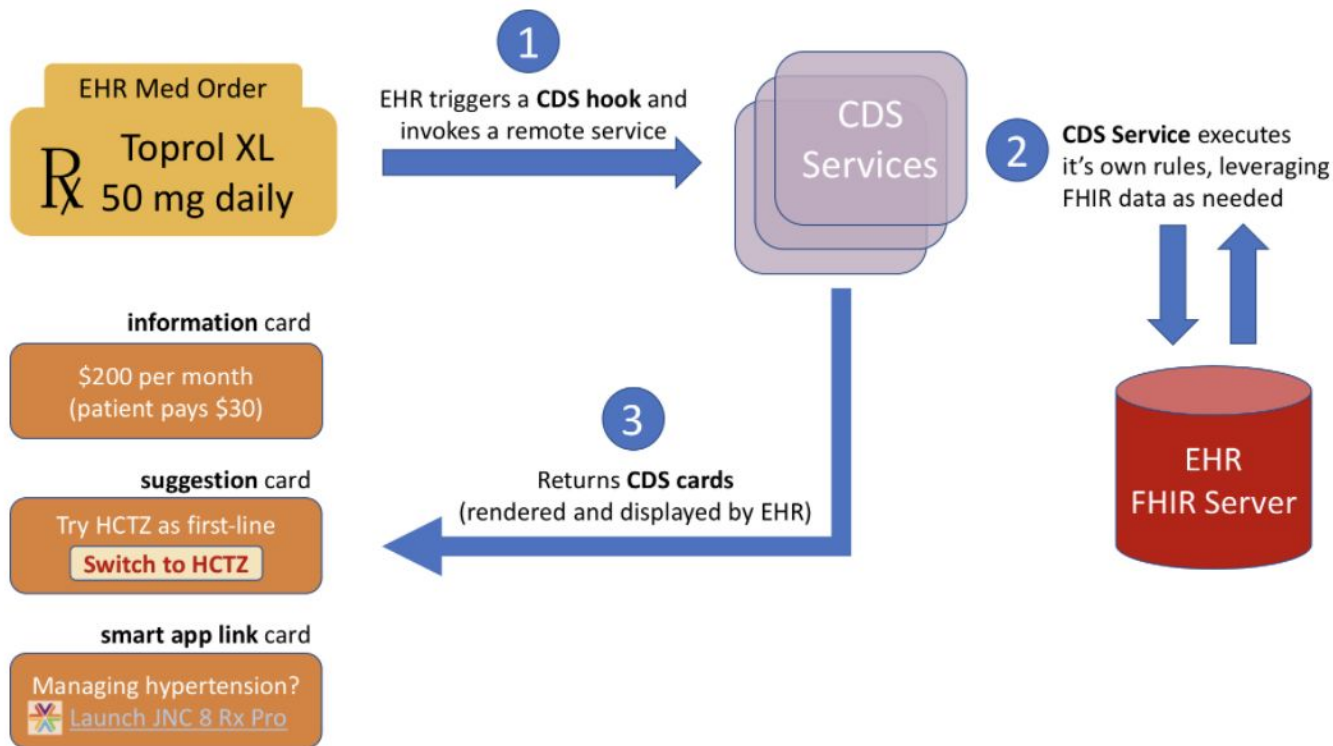
Update your information

Tier Three: Machine Intelligence

- > Passive monitoring**
- > Timely, context-aware decision support**
- > Provides**
 - Informational alerts**
 - Suggestions**
 - Ability to launch apps with context**



CDS Hooks



The Future





Apps

Categories ▾

Home

Top Charts

New Releases



My apps

Shop

Games

Family

Editors' Choice



Account

Redeem

Buy gift card

My wishlist

My Play activity

Parent Guide

Top Free in Android Apps



1. AliExpress Shop
Alibaba Mobile

★★★★★ FREE



2. South Park: Phone Destroyer
Ubisoft Entertainment

★★★★★ FREE



3. Wish - Shopping on the Web
Wish Inc.

★★★★★ FREE



4. Words With Friends 2
Zynga

★★★★★ FREE



5. Toon Blast
Peak Games

★★★★★ FREE



6. Messenger - Text and Voice
Facebook

★★★★★



7. Snapchat
Snap Inc

★★★★★



8. Dune!
VOODOO

★★★★★ FREE



9. Netflix
Netflix, Inc.

★★★★★



10. Instagram
Instagram

★★★★★



11. Bitmoji - Your Personalized Stickers
Bitstrips

★★★★★ FREE



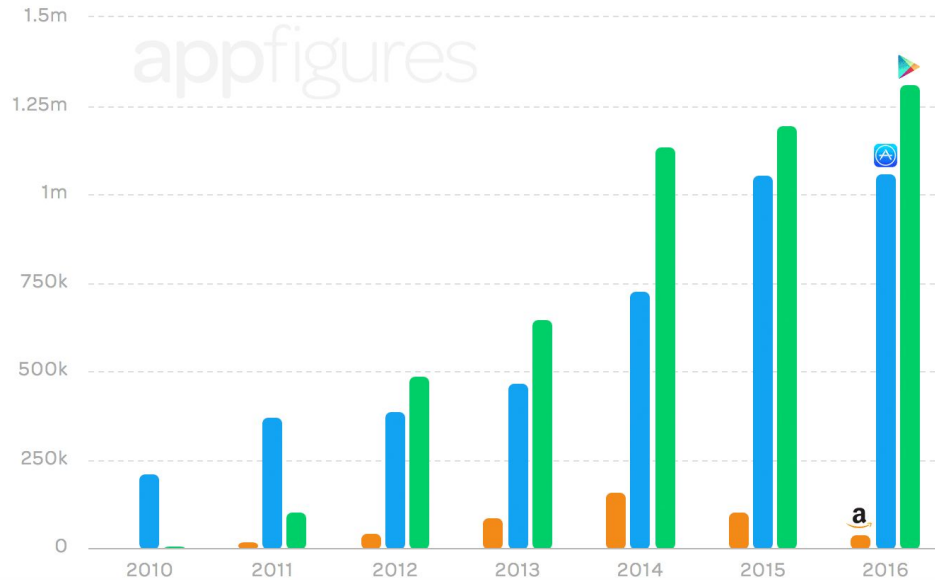
12. Facebook
Facebook

★★★★★

Apple App Store + Google Play Store



Number Of New Apps Released By Year
iOS App Store, Google Play, and Amazon Appstore



<http://blog.appfigures.com/app-stores-start-to-mature-2016-year-in-review/>


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SMART App Gallery

SMART App Gallery

apps.smarthealthit.org

Pascal

 SMART App Gallery

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Featured Apps

All Apps

Care Coordination

Clinical Research

Data Visualization

Disease Management

Genomics


Medication

Patient Engagement

Population Health

Featured Apps

Sort: Name (A-Z)




1upHealth - Aggregated Patient Data

1upHealth

Helps providers view patient data aggregated from external health systems. Patients can connect their medical data sources using FHIR.

Support: Web **Specialties:** Pediatrics, Cardiology, Trauma
Designed for: Clinicians & Patients



ACT.md

ACT.md

ACT.md extends EMR's across the community, removing the silos that prevent you from addressing social determinants of health.

Support: Web, iOS, Android **Specialties:** Oncology, Pediatrics, Rheumatology
Designed for: Clinicians & Patients

Barriers and Open Questions

Open Questions

- > What is the best monetization model?**
- > How do we address fragmentation of app stores?**
- > Who is responsible for quality control of apps?**
- > How do we catalog and disseminate useful applications?**



Thank You!

CDS Hooks

Hactivity

Resources:

psb.re/fhir